

TABLE I.

<i>parvi-maculatus</i> .	<i>cuniculus</i> .	<i>mackay-ensis</i> .	<i>mcmillani</i> .	<i>rabauli</i> .	<i>magni-maculatus</i> .	<i>mar-moratus</i> . <sup>3</sup>	<i>mag-nesianus</i> . <sup>4</sup>	<i>anten-nalis</i> .	<i>multi-maculatus</i> .	<i>angularis</i> . <sup>5</sup>	<i>bancrofti</i> .
1.15 mm.	1.28 mm.	1.41 mm.	1.66 mm.	1.49 mm.	1.58 mm.	1.54 mm.	1.54 mm.	1.50 mm.	1.73 mm.	1.63 mm.	2.15 mm.
1.24 mm.	1.31 mm.	1.38 mm.	1.41 mm.	—	1.51 mm.	1.52 mm.	1.55 mm.	1.56 mm.	—	1.77 mm.	2.02 mm.
1.09—	1.23—	1.33—	1.28—	—	1.34—	1.47—	1.50—	1.46—	—	1.60—	1.92—
1.32 mm.	1.37 mm.	1.45 mm.	1.54 mm.	—	1.60 mm.	1.62 mm.	1.64 mm.	1.66 mm.	—	2.09 mm.	2.18 mm.
250 $\mu$	305 $\mu$	265 $\mu$	320 $\mu$	280 $\mu$	340 $\mu$	305 $\mu$	270 $\mu$	435 $\mu$	—	270 $\mu$	640 $\mu$
250 $\mu$	280 $\mu$	355 $\mu$	345 $\mu$	395 $\mu$	340 $\mu$	360 $\mu$	475 $\mu$	385 $\mu$	346 $\mu$	500 $\mu$	525 $\mu$
265 $\mu$	295 $\mu$	285 $\mu$	295 $\mu$	—	325 $\mu$	325 $\mu$	255 $\mu$	470 $\mu$	—	265 $\mu$	650 $\mu$
265 $\mu$	295 $\mu$	355 $\mu$	305 $\mu$	—	335 $\mu$	355 $\mu$	470 $\mu$	385 $\mu$	—	505 $\mu$	445 $\mu$
65 $\mu$	85 $\mu$	85 $\mu$	130 $\mu$	100 $\mu$	125 $\mu$	65 $\mu$	75 $\mu$ <sup>7</sup>	110 $\mu$	—	90 $\mu$	100 $\mu$
50 $\mu$	70 $\mu$	85 $\mu$	100 $\mu$	90 $\mu$	75 $\mu$	80 $\mu$	75 $\mu$	125 $\mu$	—	100 $\mu$	165 $\mu$
25 $\mu$	25 $\mu$	25 $\mu$	35 $\mu$	25 $\mu$	35 $\mu$	35 $\mu$	30 $\mu$	50 $\mu$	—	35 $\mu$	40 $\mu$
25 $\mu$	30 $\mu$	25 $\mu$	35 $\mu$	25 $\mu$	35 $\mu$	35 $\mu$	40 $\mu$	35 $\mu$	—	25 $\mu$	35 $\mu$
360 $\mu$	420 $\mu$	460 $\mu$	510 $\mu$	—	500 $\mu$	510 $\mu$	525 $\mu$	540 $\mu$	—	540 $\mu$	745 $\mu$
345 $\mu$	420 $\mu$	435 $\mu$	510 $\mu$	—	500 $\mu$	485 $\mu$	510 $\mu$	525 $\mu$	—	525 $\mu$	745 $\mu$
170 $\mu$	205 $\mu$	220 $\mu$	265 $\mu$	280 $\mu$	230 $\mu$	230 $\mu$	270 $\mu$	225 $\mu$	—	270 $\mu$	360 $\mu$
85 $\mu$	115 $\mu$	120 $\mu$	130 $\mu$	140 $\mu$	130 $\mu$	130 $\mu$	140 $\mu$	140 $\mu$	—	140 $\mu$	205 $\mu$
60 $\mu$	80 $\mu$	75 $\mu$	100 $\mu$	90 $\mu$	90 $\mu$	90 $\mu$	75 $\mu$	90 $\mu$	—	90 $\mu$	130 $\mu$
45 $\mu$	55 $\mu$	55 $\mu$	65 $\mu$	65 $\mu$	65 $\mu$	60 $\mu$	55 $\mu$	65 $\mu$	—	60 $\mu$	90 $\mu$
55 $\mu$	65 $\mu$	60 $\mu$	65 $\mu$	65 $\mu$	65 $\mu$	60 $\mu$	65 $\mu$	65 $\mu$	—	55 $\mu$	90 $\mu$
185 $\mu$	215 $\mu$	230 $\mu$	225 $\mu$	—	225 $\mu$	235 $\mu$	265 $\mu$	270 $\mu$	—	280 $\mu$	370 $\mu$
55 $\mu$	120 $\mu$	115 $\mu$	105 $\mu$	—	130 $\mu$	135 $\mu$	140 $\mu$	145 $\mu$	—	145 $\mu$	210 $\mu$
35 $\times$ 25 $\mu$	85 $\times$ 65 $\mu$	95 $\times$ 50 $\mu$	60 $\times$ 45 $\mu$ <sup>6</sup>	—	55 $\times$ 45 $\mu$	55 $\times$ 45 $\mu$	65 $\times$ 50 $\mu$	60 $\times$ 50 $\mu$	—	55 $\times$ 45 $\mu$	90 $\times$ 50 $\mu$ <sup>7</sup>
duct 15 $\mu$	—	with duct	—	—	—	—	—	—	—	—	—
25 $\times$ 25 $\mu$	—	20 $\times$ 10 $\mu$	—	—	50 $\times$ 40 $\mu$	50 $\times$ 50 $\mu$	65 $\times$ 40 $\mu$	55 $\times$ 45 $\mu$	—	55 $\times$ 45 $\mu$	85 $\times$ 55 $\mu$
duct 15 $\mu$	75 $\times$ 60 $\mu$	—	55 $\times$ 45 $\mu$	—	—	—	—	—	—	—	—
25 $\times$ 20 $\mu$	15 $\times$ 5 $\mu$	—	—	—	—	—	—	—	—	—	—
duct 20 $\mu$	(duct)	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—

<sup>4</sup> Individual measurements from paratype.<sup>5</sup> Individual measurements from specimen from Cooranbong, 24:ix:1949.<sup>6</sup> Specimen from Woodford, x:1950.<sup>7</sup> Slightly collapsed.

(b) Species in which the distal portion of the second radial cell is pale, i.e., the pale spot adjacent to the termination of  $R_{4+5}$  includes the second radial cell, at least in part. Ten species are included in this group, namely *robertsi*,<sup>1</sup> *antennalis*, *bancrofti*, *magni-maculatus*, *cuniculus*, *dycei*, *multimaculatus*, *mcmillani*, *parvimaculatus* and *marksii* (Group II).

*Key to Australian Species of Culicoides.*

1. Wing without any pale area over the second radial cell; usually this area appears quite dark ..... 2
- Wing with the second radial cell pale distally (i.e., the pale spot adjacent to the termination of  $R_{4+5}$  includes portion of the second radial cell) ..... 13
2. (1) Legs with fourth tarsal segments cordiform ..... 3
- Legs with fourth tarsal segments subcylindrical ..... 5
3. (2) Wings without any pale area in the intercalary fork ..... *C. subimmaculatus*.
- Wings with one or two pale areas in the intercalary fork ..... 4

<sup>1</sup> *C. robertsi* is a very small species and the character on which this basic segregation is made is difficult to determine. Nevertheless, most mounted specimens will disclose that it properly belongs in Group II.

4. (3) Wings with one large pale area in the intercalary fork; wing spotting comprising very large pale areas rather weakly contrasting with the interspersed darker parts; distal antennal segments 11-15 very markedly longer than the basal flagellar segments 3-10 ..... *C. magnesianus*.  
Wings with two pale areas in the intercalary fork; distal antennal segments 11-15 not showing marked contrast to basal segments 3-10 ..... *C. molestus*.
5. (2) Wing without pale area in the intercalary fork ..... 6  
Wing with obvious pale area in the intercalary fork ..... 7
6. (5) No pale spotting on any part of wing; macrotrichia abundant ..... *C. immaculatus*.  
Pale spotting apparent on wing, macrotrichia only moderately developed .....  
..... *C. palpatis* (in part).
7. (5) Cell  $M_4$  of wing with irregularly shaped, recurved or angular pale spot ..... 8  
Cell  $M_4$  of wing with pale spot rounded or approximately so, but always without any partially enclosed dark area ..... 9
8. (7) Wing with pale spot in cell  $M_4$  often divided into two; larger species with wing length greater than 1.5 mm. .... *C. angularis*.  
Wing with pale spot in cell  $M_4$  undivided, smaller species with wing length less than 1.5 mm. .... *C. rabaudi*.
9. (7) Third segment of palp grossly swollen, ovoid, with single round sensory pit .....  
..... *C. palpatis* (in part). 10  
Third segment of palp not as above, with one or more sensory pits ..... 10
10. (9) Wing with many small pale spots; spot over r-m narrow and straight-sided, expanding towards costa; small round pale spot almost at extremity of intercalary fork, pale spot adjacent to  $R_{4+5}$  including basal portion of intercalary fork but with a broad dark area between it and the distal spot; a single elongate tapering spermatheca ..... *C. mackayensis*  
Wing with fewer pale spots; separation of spots at base and apex of intercalary fork not so pronounced; spermathecae otherwise ..... 11
11. (10) A small species with distinctive wing pattern; spot adjacent to  $R_{4+5}$  squarish and large, spot distally over intercalary fork large, triangular with longest side reaching wing margin; macrotrichia very sparse, restricted to wing tip .... *C. robertsi* (in part).  
Larger species with wing pattern not as above, macrotrichia fairly dense ..... 12
12. (11) Third segment of palp with single round sensory pit ..... *C. ornatus*.  
Third segment of palp with multiple sensory pits ..... *C. marmoratus*.
13. (1) Wings with only one pale area in the intercalary fork (excluding any intrusion of the spot adjacent to  $R_{4+5}$  over the base of the intercalary fork area) ..... 14  
Wings with two or more pale spots in the intercalary fork area ..... 17
14. (13) Antennae with basal flagellar segments 3-10 long and vasiform ..... 15  
Antennae with basal flagellar segments 3-10 shorter and subcylindrical ..... 16
15. (14) Third segment of palp elongate, with single flask-shaped sensory pit .. *C. antennalis*.  
Third segment of palp elongate, with many small round sensory pits .... *C. bancrofti*.
16. (14) Small species; wing almost devoid of macrotrichia, pale area over end of second radial cell not easily seen ..... *C. robertsi* (in part).  
Larger species; wing with dense macrotrichia, pale spots large and obvious, spot over the end of the second radial cell quite distinct ..... *C. magnimaculatus*.
17. (13) Wing with two spots in distal part of intercalary fork, one more or less above the other ..... *C. cuniculus*.  
Wing with three spots in the intercalary fork ..... 18
18. (17) Wing with only one pale spot in cell  $M_4$  ..... 19  
Wing with two pale spots in cell  $M_4$  ..... 21
19. (18) Third segment of palp with three irregular sensory pits ..... *C. multimaculatus*.  
Third segment of palp with only one sensory pit ..... 20
20. (19) Antennae short, distal flagellar segments 11-15 scarcely longer than basal ones. Third segment of palp short and wide, not as long as the fourth and fifth together ....  
..... *C. dycei*.  
Antennae longer, distal segments 11-15 distinctly longer than the basal ones. Third segment of palp long and narrow, longer than the fourth and fifth together ....  
..... *C. mcmillani*.
21. (18) Wings with pale spots moderately large; spermathecae three in number with ducts and basal portions of body unchitinized ..... *C. marksii*.  
Wings with pale spots quite small; spermathecae three in number with ducts heavily chitinized, bodies very weakly so ..... *C. parvimaeculatus*.

## DESCRIPTION OF SPECIES.

## GROUP I.

## CULICOIDES IMMACULATUS, n. sp.

*Types*: Holotype ♀ and two ♀♀ paratypes mounted on slides in SPHTM.

*Type Locality*.—Holotype from Yam I., near Cape York, 22:viii:1949 (I. M. Mackerras, in well, biting); one paratype from Red I. Point, Cape York, North Queensland, 25:viii:1949 (I. M. Mackerras, biting); the other from Thursday I., 18:viii:1949 (I. M. Mackerras, biting in mangrove swamp).

*Distinctive Characters*.—This species has no obvious wing spots. It is only likely to be confused with *C. subimmaculatus*, but the absence of a pale spot over r-m, the greater abundance of macrotrichia and the subcylindrical tarsus IV (as compared with the cordate tarsus IV of *C. subimmaculatus*) should readily distinguish it. See also under *C. palpalis* for characters differentiating it and *C. immaculatus*.

*Description*.—As no dry unmounted material is available it is not possible to give details of coloration. Measurements are given for the holotype, average measurements are from the two paratypes only (Table 1).

*Female*.

*Head*: Eyes only moderately separated (Text-fig. 1), antennae with basal flagellar segments subcylindrical, wider near base than distally, distal segments normally elongate and no unusual contrast between the two (Text-fig. 19). Mouth parts equal in length to the height of the head, palpi with moderately enlarged third segment with single round sensory pit distally (Text-fig. 38).

*Thorax*: Legs in mounted specimens showing no trace of the bands on femora or tibiae which can be seen in most species. Tarsus IV is unmodified, the tibial comb is composed of four long spines.

The wings have the area enclosed by C and R darker than the rest of the wing, no evidence of wing spotting, and macrotrichiae moderately dense over all the wing surface (see Plate xvi, fig 1).

*Abdomen*: There are two subequal subspherical spermathecae each with a very short chitinized duct.

*Male*: This sex has not been taken.

*Distribution*.—QUEENSLAND: Cape York area, North Queensland (type series); Fantome I. near Townsville, v:1949 (E. J. Reye); Goat I., Moreton Bay, 24:x:1950 (E. J. Reye, biting).

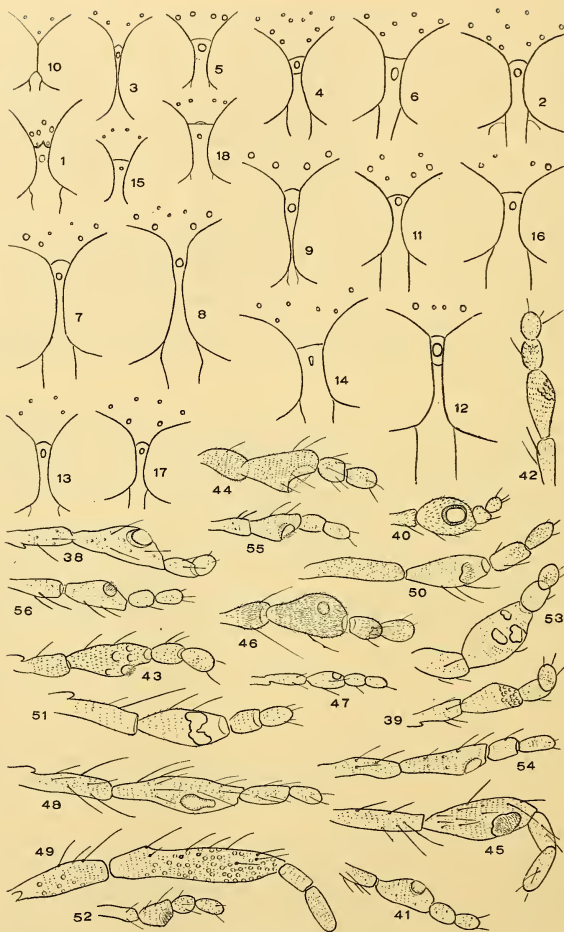
## CULICOIDES SUBIMMACULATUS, n. sp.

*Types*: Holotype ♀ and 26 ♀♀ paratypes, all slide mounts. Holotype and paratype series in SPHTM, other paratypes in BM, USNM, QIMR, and CSIRO.

*Type Locality*.—All of type series from Palm Beach, New South Wales, 2:iii:1946 (D. J. Lee). They were taken biting man in considerable numbers in the late afternoon in bush about 300 feet above sea level.

*Distinctive Characters*.—*C. subimmaculatus* is distinguishable from *C. immaculatus* on the characters outlined under the latter species. Confusion might also arise with *C. palpalis* in which some spotting can usually be detected in cell M, and the anal cell (no spots in these areas in *C. subimmaculatus*). It lacks the excessively swollen third palpal segment of *C. palpalis* and tarsus IV is cordate, a character only found elsewhere in *C. molestus* and *C. magnesianus*.

*Description*.—Essentially from the type series, coloration characters from pinned specimens from Mosman, New South Wales, 19:xi:1923 (Mackerras) and male characters from specimens from Coff's Harbour, New South Wales, 17:viii:1952 (E. J. Reye, in net, 1600 hours). Measurements are given for the holotype, average measurements from ten paratypes and for the male sex a series of eight specimens from Coff's Harbour has been used (see Table 1).



Text-figures 1-18. Interorbital space of various species. ( $\times 190$  approx.)

1, *C. immaculatus*; 2, *C. subimmaculatus*; 3, *C. palpalis*; 4, *C. ornatus*; 5, *C. molestus*; 6, *C. marmoratus*; 7, *C. mackayensis*; 8, *C. angularis*; 9, *C. magnesianus*; 10, *C. robertsi*; 11, *C. antennalis*; 12, *C. bancrofti*; 13, *C. magnimaculatus*; 14, *C. cuniculus*; 15, *C. dycei*; 16, *C. mcmillani*; 17, *C. parvimaclulatus*; 18, *C. marksi*.

Text-figures 1, 2, 10, 11, 13, 14, 16, 17 and 18 drawn from holotype specimens; 3, 4, 7, 9 and 15 from paratypes; 5 and 6 from specimens in the selected series mentioned in the description; 8, a specimen from Cooranbong and 12, a specimen from Hornsby.

Text-figures 38-56. Palp of various species. ( $\times 190$  approx.)

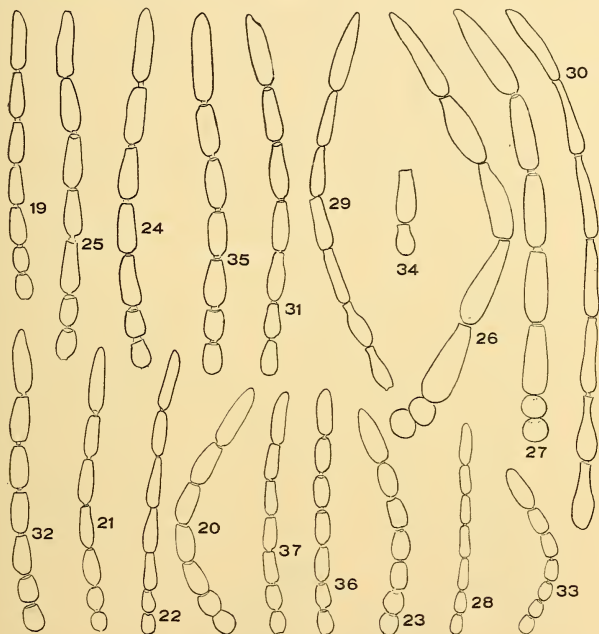
38, *C. immaculatus*; 39, *C. subimmaculatus*; 40, *C. palpalis*; 41, *C. ornatus*; 42, *C. molestus*; 43, *C. marmoratus*; 44, *C. mackayensis*; 45, *C. angularis*; 46, *C. magnesianus*; 47, *C. robertsi*; 48, *C. antennalis*; 49, *C. bancrofti*; 50, *C. magnimaculatus*; 51, *C. cuniculus*; 52, *C. dycei*; 53, *C. multimaculatus*; 54, *C. mcmillani*; 55, *C. parvimaclulatus*; 56, *C. marksi*.

Text-figures 38, 47, 48, 53 drawn from holotypes; 39, 40, 41, 44, 45, 46, 49, 50, 51, 52, 55 and 56 from paratypes; 42 and 43 from specimens in the selected series mentioned in the text; 54, a specimen from Woodford.



*Female.*

The head is dark brown with lighter brownish bloom dorsally, the antennae and palpi are dark brown. The scutum has no pattern of spots or bands and is almost entirely covered by a dull yellowish-brown bloom similar to that on the head and also on the scutellum. The pleura are dark brown, the legs brown with no trace of banding. Halteres yellowish. Abdomen dark brown.



Text-figures 19-37. Segments 9-15 of the antenna of various species.

(Figs. 19-33,  $\times 150$ ; 34-37,  $\times 190$  approx.)

19, *C. immaculatus*; 20, *C. subimmaculatus*; 21, *C. palpalis*; 22, *C. ornatus*; 23, *C. molestus*; 24, *C. marmoratus*; 25, *C. mackayensis*; 26, *C. angularis*; 27, *C. magnesianus*; 28, *C. robertsi*; 29, *C. antennalis*; 30, *C. bancrofti*; 31, *C. magnimaculatus*; 32, *C. cuniculus*; 33, *C. dycei*; 34, *C. multimaculatus* (segments 10 and 11 only); 35, *C. mcmillani*; 36, *C. parvimaculatus*; 37, *C. marksii*.

Text-figures 19, 20, 27, 29, 31, 34, 35 and 36 drawn from holotypes; 21, 22, 25, 26, 28, 30, 32, 33 and 37 from paratypes; 23 and 24 from the selected series mentioned in the description.

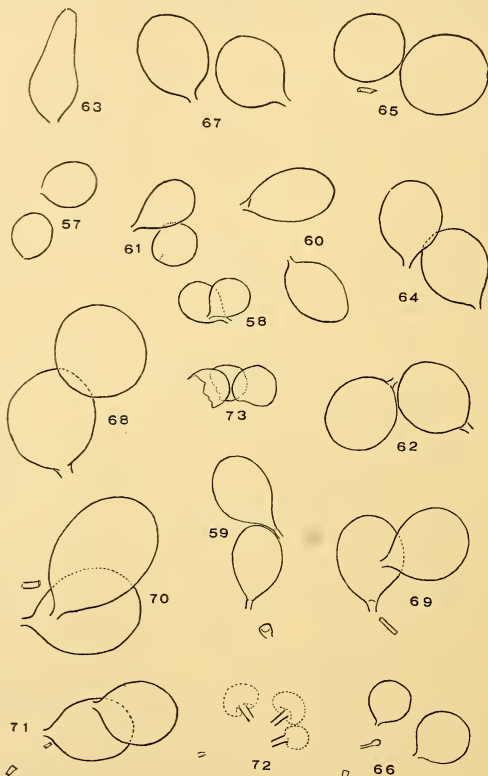
*Head:* The eyes are well divided (Text-fig. 2), the antennae (Text-fig. 20) short with the basal flagellar segments subspherical and the distal five normally elongate. The third segment of the palpus is moderately enlarged with a series of many very small sensory pits on the distal half (Text-fig. 39). Length of mouth parts less than height of head.

*Thorax:* Tarsus IV of all legs cordate (Text-fig. 77); tibial comb comprising four spines. The wings are greyish with no strongly contrasting pattern but only two small pale areas, one over r-m, the other adjacent to the termination of  $R_{4+5}$ . Macrotrichia sparse (see Plate xvi, fig. 4).

*Abdomen:* Two subequal subspherical spermathecae with short chitinous ducts, one narrow elongate duct and a short broad duct (Text-fig. 58).

*Male.*

Apart from the usual sexual differences, essentially similar to the female. Genitalia with harpes as in Text-fig. 77.



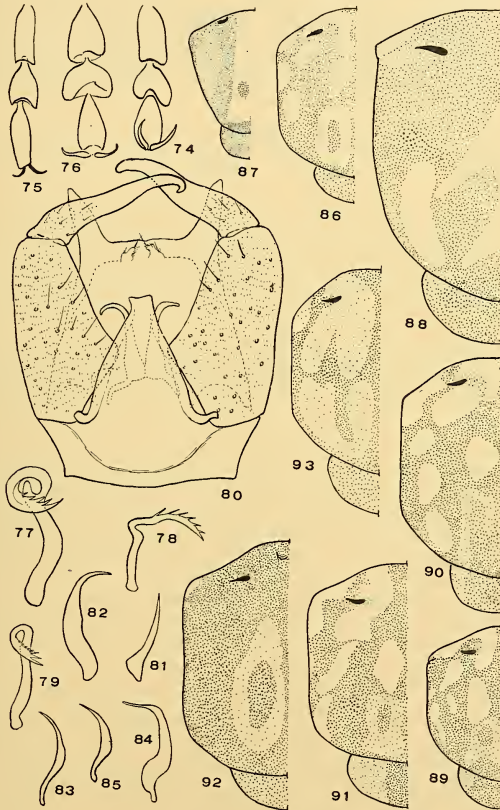
Text-figures 57-73. Spermathecae of various species. ( $\times 250$ .)

57, *C. immaculatus*; 58, *C. subimmaculatus*; 59, *C. palpalis*; 60, *C. ornatus*; 61, *C. molestus*; 62, *C. marmoratus*; 63, *C. mackayensis*; 64, *C. angularis*; 65, *C. magnesianus*; 66, *C. robertsi*; 67, *C. antennalis*; 68, *C. bancrofti*; 69, *C. magnimaculatus*; 70, *C. cuniculus*; 71, *C. mcmillani*; 72, *C. parvimaculatus*; 73, *C. marksi*.

Text-figures 66, 67, 69, 70 and 73 drawn from holotypes; 57, 58, 59, 60, 63, 65 and 72 from paratypes; 61 and 62 from specimens in the selected series mentioned in the text; 64, a specimen from Cooranbong; 68, one from N. of Coff's Harbour, 71 a specimen from Woodford.

*Distribution.*—QUEENSLAND: Magnetic I., 9:vii:1952 (E. J. Reye, biting man, 1600 hrs.); South Townsville, 11:vii:1952 (E. J. Reye, biting man, 1630 hrs.); Bowen, (S. J. Crighton), 14:vii:1952 (E. J. Reye, biting in bush, 1000 hrs.); Bucasia, iii:1951 (H. A. Edmonds); Fraser I., 14:ii:1949 (biting fiercely), 9:xii:1952 (biting in daylight, seashore mangroves); Tin Can Bay, 17:iv:1938 (R. V. Smythe, biting); Noosa, 7:v:1949 (M. J. Mackerras, resting in tent); Maroochydore, 31:x:1951 (M. A. Reye); Redcliffe, 10:ix:1938 (F. A. Perkins); Fisherman I., 12:i:1951, 9:xii:1951 (E. J. Reye, biting, 1800 hrs.); Lota, 7:i:1952 (E. J. Reye, biting); Peel I., 30:x:1950 (E. J. Reye),

6:ix:1951 (E. J. Reye, biting, 1530 hrs.); Goat I., 3:x:1950, 24:x:1950 (E. J. Reye); Southport, 3:ii:1952 (E. J. Reye, biting); Texas, 22:xii:1951 (E. J. Reye, light trap, 2000 hrs.). NEW SOUTH WALES: Boonoo Boonoo Falls, 1:v:1938; Tweed Heads, xii:1948; Evans Head, 26:ix:1950 (M. J. Mackerras); Moonce Beach, 18:x:1950 (M. J. Mackerras, biting at dusk); Mooni, Coff's Harbour, 14:ii:1925; Coff's Harbour, 17:viii:1952 (E. J. Reye, 1630 hrs., net in creek flat mangroves); Bob's Farm, 25:i:1942 (0600-0700,



Text-figures 74-76. Tarsal segments III-V. ( $\times 250$ )  
74, *C. subimmaculatus*; 75, *C. ornatus*; 76, *C. molestus*.

Text-figures 77-85. Harpes. ( $\times 250$ )

77, *C. subimmaculatus*; 78, *C. palpalis*; 79, *C. marmoratus*; 80, *C. angularis* (complete male genitalia); 81, *C. robertsi*; 82, *C. magnimaculatus*; 83, *C. dycei*; 84, *C. parvimaculatus*; 85, *C. marksi*.

Text-figures 86-93. Scutal patterns. ( $\times 70$ )

86, *C. palpalis*; 87, *C. robertsi*; 88, *C. bancrofti*; 89, *C. dycei*; 90, *C. parvimaculatus*; 91, *C. marksi*; 92, *C. antennalis*; 93, *C. marmoratus*.

Text-figure 74 drawn from holotype; 75 from a paratype; 76 from a specimen in the selected series mentioned in the description; 81 and 85 from allotypes; the rest as mentioned in the descriptions of the individual species.

biting); Palm Beach, 2:iii:1946 (D. J. Lee); Careel Bay, 3:ii:1949 (biting), 16:ii:1949 (D. J. Lee, biting, 12 noon); Avalon, 25:i:1949 (K. O'Gower); Narrabeen, 29:ix:1948 (B. McMillan); Cowan Cr., 29:x:1949 (B. McMillan); Hornsby, 6:x:1951 (D. J. Lee and B. McMillan); McCarr's Cr., 17:xi:1947 (biting, mangrove flat, 5.30 p.m.); Castle-crag, 13:xi:1951 (Dr. Hedburg); Roseville, 13:x:1923 (Nicholson); Mosman, 19:xi:1923 (Mackerras); Walsh L., 29:i:1949 (B. McMillan); Oyster Bay, 1:i:1950, 8:i:1950, ii:1950, xi:1950 (Brown-Deverell), 29:i:1951 (Mrs. Amos); Oatley Park, 27:ix:1952 (E. J. Reye, net, 1415 hrs.); Woolooware Bay, 27:ix:1952 (E. J. Reye, net, 1645 hrs.); Quibray Bay, 14:xii:1948, 28:x:1952 (E. J. Reye, net, 1000 hrs.); Burraneer Bay, 25:xi:1950 (Kinsella); Cronulla, 25:ii:1942 (in car headlights); Woronora, 11:x:1952 (E. J. Reye, 1630 hrs., net among mangroves); Port Kembla, 20:x:1949; Merimbula, 17:xi:1948 (E. Pratt).

CULICOIDES PALPALIS, n. sp.

*Types*: Holotype ♀, allotype ♂, together with 17 ♀♀ and 15 ♂♂ paratype slides. Holotype, allotype and paratype series in SPHTM. Other paratypes in BM, USNM, QIMR and CSIRO.

*Type Locality*.—Texas, Queensland (on New South Wales border). All specimens in type series taken in light trap, 20:i:1952 (A. L. Dyce).

*Distinctive Characters*.—This species is particularly characterized by the grossly swollen third segment of the palpi. The wing has a faint but definite pattern which, in contrast to *C. immaculatus* and *C. subimmaculatus*, includes the posterior part of the wing.

*Description*.—From the type series except for coloration characters which are taken from pinned specimens from Bundy, via Moree, v:1952 (E. J. Reye). Measurements are given for the holotype and a series of ten paratypes of each sex (Table 1).

*Female*.

Generally dark brown in colour, including antennae, palpi, thorax and abdomen. Scutum with complex greyish pattern (see Text-fig. 86). Legs rather lighter brown than rest of body, with the bases of all tibiae pale, the apices of fore and mid femora also pale, but not quite so obviously, and the bases of fore and mid femora also pale. Wings with pattern of fair but not strong contrast (Plate xvi, figs. 2 and 3), macrotrichiae moderate in density, radial cells dark brown except at base of first. Halteres pale yellowish.

*Head*: Antennae with basal segments of flagellum globular, distal segments elongate, each approximately twice as long as the individual basal segments, except 15 which is about half as long again as the penultimate (Text-fig. 21). Palpi with second segment elongate and expanded apically, third segment ovoid, grossly enlarged, longer than wide with maximum width at middle, sensory organ as in Text-figure 40. Fourth segment very small and globular, fifth also small but ovoid in shape. The eyes are narrowly separated in the inter-orbital area (Text-fig. 3). Mouth-parts rather less in length than height of the head.

*Thorax*: The pattern of the scutum is of the form shown in Text-figure 86. The legs are as described above, the tibial comb comprises four spines, the first rather longer than the other three. Tarsus IV is subcylindrical.

*Abdomen*: The spermathecae are as in Text-figure 59.

*Male*.

This sex possesses a similar wing pattern to that of the female although the spotting tends to be less intense and the macrotrichia are rather more sparse. The palpi are similar in form except that the third segment is smaller although the same proportions are maintained. The harpes are as in Text-figure 78.

*Distribution*.—QUEENSLAND: Blue Mts. Goldfield, Cape York Pen., 14:xi:1947 (J. L. Wassell, light trap); Magnetic I., 9:xii:1952 (E. J. Reye, in net, 1000 hrs. and 1530 hrs.); Bowen, 14:vii:1952 (E. J. Reye, in net, 1200 hrs.); Mirani, 15:vii:1952 (E. J. Reye, in net, 1200 hrs.); Longreach, 1951 (R. F. Riek, light trap); Gootchie, 20:vii:1952



(E. J. Reye, in net, 1600 hrs.); Dayboro, 7:viii:1951 (E. J. Reye, culture from pond edge); Roma, 11:v:1948 (J. L. Wassell, 2100-2200 hrs.); Yeerongpilly, 15:iv:1952 (R. F. Riek, light trap); Noondoo, iii:1951; Texas, 20:i:1952 (A. L. Dyce). NEW SOUTH WALES: Gravesend, 12:vi:1952 (E. J. Reye, 1600-1700 hrs., in net); Yagobie, 3:xii:1951 (A. L. Dyce, 1925-0500 hrs., light trap); Biniguy, 19:x:1951 (A. L. Dyce); Moree, 10:xi:1951 (A. L. Dyce, 1830-2130 hrs., Mercury vapour light trap), 11:xi:1951 (A. L. Dyce, dusk to 2130 hrs., M.V. light trap), 22:xi:1951 (A. L. Dyce, M.V. light trap); 23-24:xi:1951 (A. L. Dyce, 1830-0500, M.V. light trap), 25:xi:1951 (A. L. Dyce, M.V. light trap); Bundy, via Moree, 30:x:1951 (A. L. Dyce, light trap), 7:xi:1951 (A. L. Dyce, rabbit modified trap, 9.30-11.30 a.m.), 6:xii:1951 (A. L. Dyce, 6-9 p.m., M.V. trap), 6-7:xii:1951 (A. L. Dyce, live rabbit trap, suction, 5 p.m.-10 a.m.), 2:v:1952 (E. J. Reye), 24:v:1952 (E. J. Reye, 2300 hrs., Mercury vapour light trap in caravan), 29:v:1952 (E. J. Reye, 1730-1950 hrs., light trap), 7:vi:1952 (E. J. Reye, 1600 hrs., net); Castle Hill, 29:x:1952 (D. J. Lee, light trap), 31:x:1952 (D. J. Lee, light trap).

#### CULICOIDES ORNATUS Taylor.

Taylor, F. H., 1911.—*Rept. Aust. Inst. Trop. Med.*: 73.

*Types*: I have been unable to trace the type of this species (or, indeed, any specimens identified by Taylor) and must assume that it is no longer in existence. This assumption is corroborated by correspondence on file in the School of Public Health and Tropical Medicine, Sydney, wherein it is disclosed that the author of the species was himself unable to locate the type (correspondence with J. W. S. Macfie, 1939). In view of this evidence it has been considered advisable to set up a new type series comprising a neotype ♀ and 26 ♀♀ neoparatypes. Neotype and neoparatype series in SPHTM, other neoparatypes in BM, USNM, CSIRO and QIMR.

*Type Locality*.—All the above from Magnetic I., Queensland, 9:vii:1952 (E. J. Reye, 1600 hrs.). This locality is less than five miles from the original type locality of Townsville.

*Distinctive Characters*.—This species most resembles *C. molestus*, from which it differs in having the pale spot on the costa immediately adjacent to  $R_{4+5}$  returning backward below the radial cells and in having only one spot within the intercalary fork instead of two. Tarsus IV is not cordate as in *C. molestus* and there is a single sensory pit on the third segment of the palpi.

*Description*.—From the neotype series except for coloration characters which are taken from specimens from Gladstone and Darwin. Measurements of a single specimen are given from a neoparatype, average measurements from a series of ten neoparatypes (Table 1).

#### Female.

A small brown species with brown antennae and palpi, darker brown thorax and abdomen. Scutum with complex grey pattern anteriorly and laterally. Scutellum dark brown. Femora dark brown, tibiae light brown with dark brown tips, tarsi mainly light brown, rather darker on basal portion of Tarsus I. Wings with fair but not strong contrast, macrotrichia moderately dense over most of wing. Halteres creamy-white.

*Head*: Antennae with basal segments of flagellum subcylindrical, distal segments normally elongate (Text-fig. 22). Third segment of palpi expanded distally with a single round sensory pit (Text-fig. 41). Eyes moderately separated (Text-fig. 4). Mouth-parts almost equal in length to height of head.

*Thorax*: Legs without any obvious modifications, Tarsus IV not cordate but rather bell-shaped (Text-fig. 75). Tibial comb of four spines. Wings as illustrated in Plate xvi, fig. 5.

*Abdomen*: Two subequal round to ovoid spermathecae, each with short chitinized duct (Text-fig. 60).

*Male*: This sex has not so far been taken.

*Distribution*.—WESTERN AUSTRALIA: Wyndham, ii:1931 (H. J. Willings); Port Hedland, 6:i:1948 (Dept. Agric.). NORTHERN TERRITORY: Bathurst I., Reichart's Cr., near

Darwin, 18:xi:1942 (A. R. Woodhill); Berry's Springs, near Darwin, 18:xi:1942 (A. R. Woodhill). QUEENSLAND: Yam I., Cape York, 23:viii:1949 (I. M. Mackerras, in well); Cairns, 27:xii:1942 (A. R. McCulloch); Palm I., 2:vi:1948 (J. L. Wassell, edge of scrub, in light trap, 8-9 p.m.); Townsville, xi:1945 (A. J. Bearup); Magnetic I., 9:vii:1952 (E. J. Reye, in net and biting, 1530 hrs.); South Townsville, 11:vii:1952 (E. J. Reye, in net and biting, 1630 hrs.); Gladstone, 23:i:1947 (E. N. Marks, biting in hospital); Fraser I., 9:xii:1938 (biting in daylight, seashore mangroves); Comsle, 19:xi:1951 (R. F. Riek, biting horse).

CULICOIDES MOLESTUS (Skuse).

Skuse, F. A., 1889. PROC. LINN. SOC. N.S.W., 4 (2nd series): 305 (*Ceratopogon*).

Kieffer, J. J., 1906. Chironomidae in Wytzman's Genera Insectorum, fasc 42: 54 (*Culicoides*).

Maclef, J. W. S., 1939. PROC. LINN. SOC. N.S.W., 64: 556.

*Type*: Holotype ♀ in Macleay Museum, University of Sydney.

*Type Locality*.—Berowra, New South Wales (January).

*Synonymy*: *Ceratopogon molestus* Skuse, 1889, *loc. cit.*—*Nec Culicoides molestus* Kieffer, J. J., 1910, *Mem. Ind. Mus.*, 2, No. 4: 192.

*Distinctive Characters*.—Two pale spots in the intercalary fork area, no pale area immediately below the second radial cell and the cordate Tarsus IV separate this from its closest ally, *C. ornatus*. The sensory pits on the third palpal segment are multiple.

*Female*.

Additional data on this species (including average measurements of ten specimens) have been provided by mounted specimens taken at Berowra, 6:iii:1946 (R. H. Wharton). Individual measurements are from a specimen from Mosman, 26:i:1947 (Table 1). Details of the antennae are figured in Text-figure 23, of the palpi in Text-figure 42, of the wing in Plate xvi, fig. 6, of the tarsi in Text-figure 76, and the spermathecae in Text-figure 61. There is no distinct scutal pattern although there is a covering of yellowish-grey bloom indistinctly differentiated into a median and two lateral bands separated by two lighter submedian bands.

*Male*: No specimens of this sex are available for description.

*Distribution*.—QUEENSLAND: Cockle Bay, Magnetic I., 9:vii:1952 (E. J. Reye, biting, 1600 hrs.); South Townsville, 11:vii:1952 (E. J. Reye, biting, 1630 hrs.); Mackay, ix-x:1950; Fisherman I., 11:xii:1950 (1600 hrs.). NEW SOUTH WALES: Tilligerry Cr., 18:ii:1949 (B. McMillan); Berowra, 6:iii:1946 (D. J. Lee and R. H. Wharton); Mt. Kuring-gai, 29:x:1949 (B. McMillan); Cowan Cr., 29:x:1949 (B. McMillan); 30:xii:1951 (B. McMillan, biting, 4 p.m.), 2:iv:1952 (B. McMillan, biting 4.30 p.m.); Bobbin Head, 17:iii:1948 (B. McMillan); Kuring-gai Chase, 28:xii:1929 (L. M. Willings); Palm Beach, 2:iii:1946 (D. J. Lee); Hornsby, 14:v:1949 (biting); French's Forest, 6:iv:1949 (biting); McCarr's Cr., 29:iv:1949 (D. J. Lee, mangrove area); Killara, 11:ii:1946 (Miss Kent, biting, 6 p.m.); Mosman, 19:xi:1923 (Mackerras), 2:iv:1943 (biting), 20:i:1947 (D. J. Lee, biting at dusk), 6:iv:1947 (D. J. Lee, biting, 6 p.m.); 8:xi:1947 (D. J. Lee, biting in garden); Hunter's Hill, 14:xi:1940 (A. R. Woodhill, biting 5-7 p.m., 400 yards from salt water); Lillipilli, 9:iii:1946 (A. J. Bearup); Oyster Bay, 29:i:1951 (Mrs. Amos); Gundamain, 19:xi:1923 (Mackerras); National Park, 12:iv:1924 (Mackerras), 25:iv:1925 (Mackerras), 30:iii:1947 (B. McMillan).

CULICOIDES MARMORATUS (Skuse).

Skuse, F. A., 1889. PROC. LINN. SOC. N.S.W., 4 (2nd series): 304-5 (*Ceratopogon*).

Maclef, J. W. S., 1939. PROC. LINN. SOC. N.S.W., 64: 556.

*Type*: Holotype ♀ in Macleay Museum, University of Sydney.

*Type Locality*.—Sydney, New South Wales.

*Synonymy*.—*Ceratopogon marmoratus* Skuse, 1889, *loc. cit.*

*Distinctive Characters*.—Characters serving to differentiate this species are the form of the pale spot adjoining the distal end of the second radial cell, this spot being bilobed,

with one lobe beside the termination of the cell, the other beneath it; the single pale spot in the intercalary area which at times is indented distally, the general strength of the spotting which has a greater degree of contrast than in the preceding species; the sensory organ of the palpi which consists of one large irregular pit and a number of smaller subsidiary ones. No single character is specifically diagnostic but there should be agreement with the essential characters listed above and the wing spot distribution as figured in Plate xvi, figs. 7 and 8. Two types of wing spotting are illustrated, the difference being in the intercalary fork area. Other specimens show this pale spot considerably reduced.

Additional details of the head are provided in Text-figures 6, 24 and 43, and of the spermathecae in Text-figure 62. These are all drawn from a series of specimens from Burraneer Bay (near Sydney), New South Wales, 25:xi:1950 (Kinsella, 6 p.m.). All measurements in Table 1 are from this same series.

A male specimen from Hornsby, New South Wales, 11:xi:1950 (D. J. Lee, light trap), has been used for illustrating the harpes of the male genitalia (Text-fig. 79).

*Distribution.*—QUEENSLAND: Magnetic I., 9:vii:1952 (E. J. Reye, Mangroves, 1000 hrs.); Mackay, ix-x:1950; Noosa, 1:v:1949 (M. J. Mackerras, biting); Tin Can Bay Rd., 17:iv:1949 (biting in tent); Dayboro, 13:xi:1949 (ex horse); Auchenflower, 10:ix:1950 (J. Pope, scrub); Mt. Coot-tha, 21:xi:1949; Yeerongpilly, 5:v:1938 (F. H. S. Roberts), 3-4:i:1952 (R. F. Riek, light trap), 7:iv:1952 (R. F. Riek, light trap); Sunnybank, 19:viii:1950 (M. J. Mackerras, biting); Corinda, 18:iv:1948; Peel I., 30:x:1950 (E. J. Reye); Mt. Tambourine, 17:xi:1949; Little Nerang R., 25:ix:1949 (biting). NEW SOUTH WALES: Nelson's Bay, 4:vi:1950 (B. McMillan, 500'); Anna Bay, 21:viii:1948 (B. McMillan, biting); Newcastle, 1:1948 (B. McMillan); Mt. Kuring-gai, 29:x:1949 (B. McMillan); Cowan Cr., 29:x:1949 (B. McMillan); Hornsby Gully, 29:x:1950 (D. J. Lee and B. McMillan, 5 p.m.); Hornsby, xi:1950 (D. J. Lee, light trap), 11:xi:1950 (D. J. Lee, light trap); Palm Beach, 2:iii:1946 (D. J. Lee, biting at dusk); Narrabeen, 26:vii:1948 (B. McMillan); French's Forest, 6:iv:1949 (biting); Hunter's Hill, 14:xi:1946 (A. R. Woodhill); Mosman, 30:iii:1947 (D. J. Lee); Oatley Bay, 27:ix:1952 (E. J. Reye, 1540 hrs.); Oyster Bay, 5:xi:1950 (D. J. Lee); Woollooware Bay, 27:ix:1952 (E. J. Reye, 1645 hrs.); Burraneer Bay, 25:xi:1950 (Kinsella, 6 p.m.); Gundamain, iv:1950 (A. J. Bearup, near waterfall); National Park, Uloola Falls, 23:x:1949 (B. McMillan); National Park, 12:xi:1949 (B. McMillan); Heathcote, 13:iv:1946, 12:v:1946, 5:viii:1946, 21:ix:1946 (all J. R. Henry); Engadine, 20:ii:1947 (J. R. Henry, biting); Merimbula, 17:xi:1948 (E. Pratt).

#### CULICOIDES MACKAYENSIS, n. sp.

*Types:* Holotype ♀ and 14 ♀♀ paratype slides. Holotype and paratype series in SPHTM, paratypes in each of BM, USNM, QIMR and CSIRO.

*Type Locality.*—All the above from Mackay, Queensland, 15:vii:1952 (E. J. Reye, 1620 hrs., net in mangroves).

*Distinctive Characters.*—This species has an unusual wing spot distribution with a small pale area in the base of the intercalary fork (this spot may be confluent with the pale area surrounding the distal extremity of the second radial cell) together with a marginal pale spot near the termination of the lower branch of the intercalary fork. Another feature seen in the wing is the narrow pale area running over  $M_{3+4}$  and  $Cu_1$  (this is also seen in *C. multimaculatus*), and the pale area over r-m is a band rather than a rounded spot as in most species. The single spermatheca is also of characteristic shape (see Text-fig. 63).

*Description.*—Only the type series has been available for description. Individual measurements are from the holotype, average measurements from a series of ten paratypes (Table 1).

#### Female.

The slide specimens reveal that the legs have distinct preapical pale spots on the femora and even more obvious pale spots adjacent to the bases of the tibiae. The wings

have a complex pattern of moderately strong contrast and the halteres are obviously dark in colour.

*Head*: Eyes rather closely approximated (Text-fig. 7), antennae with basal flagellar segments not much longer than broad, distal segments elongate with rather strong contrast between the two (Text-fig. 25). The third segment of the palpi with greatest expansion near middle and a single very large sensory pit (Text-fig. 44). The mouth parts are equal in length to the height of the head.

*Thorax*: Legs with no obvious modifications, Tarsus IV subcylindrical, tibial comb of four spines. Wings with moderately dense macrotrichia, spotting as in Plate xvi, fig. 12.

*Abdomen*: A single spermatheca of unusual shape as in Text-fig. 63.

*Male*: This sex has not yet been taken.

*Distribution*.—QUEENSLAND: Only known from the type locality.

#### CULICOIDES RABAU LI Macfie.

Macfie, J. W. S., 1939. PROC. LINN. SOC. N.S.W. 64: 367.

*Type*: Holotype ♀ on slide in SPHTM.

*Type Locality*.—Rabaul, New Britain.

*Distinctive Characters*.—Despite access to the unique type which is unfortunately in a distorted condition, it has not been possible to characterize this species adequately. *C. rabauli* is one of the species with a curved or inverted V-shaped pale area inside cell M<sub>1</sub>. It is distinct from *C. marksi* since it has only one pale spot in the intercalary fork area, *C. marksi* having three.

The closest species to *C. rabauli* is *C. angularis* and it is not possible to differentiate the two adequately, although in our opinion they are distinct species. It has been thought better to describe as new *C. angularis* realizing that it may fall into synonymy when *C. rabauli* is better known rather than to risk an erroneous recording of *C. rabauli* from southern Australia. Of the characters which can be fully observed in the type of *C. rabauli* there is only one which offers a point of distinction from *C. angularis*. In cell M<sub>1</sub> the pale spot is undivided in *C. rabauli* whereas it is usually divided into a large and a small section in *C. angularis*. Details of the antennae and palpi are not sufficiently clear in the *C. rabauli* type to determine exact differences although it is considered possible that other differences may be found in these characters. A photograph of the wing of the type is included (Plate xv, fig. 10) for comparison with that of *C. angularis*. These are indicative of the difference in size which appears to be associated with the two species. Such measurements as are possible on the holotype are included in Table 1.

*Distribution*.—NEW GUINEA: Rabaul. QUEENSLAND: A small series of specimens from Heron I. has been placed tentatively as *C. rabauli* since they show the undivided pale spot in cell M<sub>1</sub>. Heron I., 24:v:1947 (J. L. Wassell, tree hole and *Pisonia* tree hole).

#### CULICOIDES ANGULARIS, n. sp.

*Types*: Holotype ♀ and 8 ♀♀ paratypes, all pinned specimens with the exception of one paratype mounted on a slide. All in SPHTM.

*Type Locality*.—Mittagong, New South Wales, 27:xi:1936 (D. J. Lee, bred from larvae found in rock pool).

*Distinctive Characters*.—See under *C. rabauli*.

*Description*.—From the type series, some additional data being provided from the specimens from Cooranbong listed below. Individual measurements are from a specimen from Cooranbong, 24:ix:1949, average from two specimens, one a paratype, the other from Cooranbong as above (Table 1).

#### Female.

A large brown species. Head dark brown including antennae and palpi. Thorax dark brown, scutum dark brown for the anterior fourth, rest covered by a golden-brown



bloom, except the prescutellar area, which is greyish. Scutellum with middle third dark brown, sides greyish. The legs are brown with a slightly paler indefinite band just before the apex of each femora and somewhat more pronounced pale band at the base of the tibiae. Wings with pattern of quite strong contrast, halteres with creamy white knobs. Abdomen dark brown.

*Head:* Eyes narrowly separated (Text-fig. 8), antenna long with short globular basal flagellar segments, and very elongated distal ones (Text-fig. 26). Palp with elongate third segment moderately swollen near middle and with a single large sensory pit (Text-fig. 45). Mouth-parts as long as height of head.

*Thorax:* Legs unmodified, Tarsus IV cylindrical. Wings with moderately dense macrotrichia, pattern as in Plate xvi, fig. 11. The pale area in cell M, is usually divided but occasionally both sections are fused.

*Abdomen:* Two subequal, subspherical spermathecae, each with short duct (Text-fig. 64).

*Male.*

A specimen from Cooranbong has been used for the figure of the male terminalia (Text-fig. 80).

*Distribution.*—QUEENSLAND: Mt. Glorious: 4:x:1952 (E. N. Marks, water-filled groove in log in rain forest). NEW SOUTH WALES: Cooranbong, 24:ix:1949 (B. McMillan, bred from tree hole); Mittagong, 27:ix:1936 (D. J. Lee, bred from rock pool).

#### CULICOIDES MAGNESIANUS, n. sp.

*Types:* Holotype ♀ and 15 ♀♀ paratypes, mounted on slides. Holotype and paratype series in SPHTM, paratypes in BM, USNM, QIMR, and CSIRO.

*Type Locality.*—Magnetic I., Queensland, 8:vii:1952 (E. J. Reye, 1700 hrs., net in mangrove).

*Distinctive Characters.*—The wing pattern of this large species is characteristic though very weak. It comprises many large pale areas separated by darker areas as shown in Plate xvi, fig. 9. Although the third segment of the palp is large and distally swollen, it is distinct from the shorter and broader segment of *C. palpalis* and the sensory organ is no more than one-third the width of the segment as compared with fully one-half in *C. palpalis*. From *C. molestus* and *C. subimmaculatus*, the other two species with Tarsus IV cordate, *C. magnesianus* is readily distinguished by its single palpal sensory organ, the other two having numerous small pits.

*Description.*—From the type series of slides, no pinned material available for coloration characters. Individual measurements are from a paratype, averages from a series of ten paratypes (Table I).

*Female.*

*Head:* Eyes narrowly separated (Text-fig. 9). Antennae with basal flagellar segments almost spherical, distal segments very elongate with very strong contrast between the two (Text-fig. 27). The mounted specimens appear to show that the pedicel and first flagellar segment and segments 10-15 are distinctly darker than the intermediate flagellar segments. The palp has a larger third segment, narrow at base and distally expanded with a single sensory pit, the diameter of which is about one-third that of the greatest width of the segment (Text-fig. 46).

*Thorax:* The femora and tibiae are dark brown, the tarsi lighter in colour. There is a distinct pale band basally on each tibia and Tarsus IV is strongly cordiform. Wings (see Plate xvi, fig. 9). The halteres are dark in colour.

*Abdomen:* There are two subequal spherical spermathecae, together with a small isolated duct which in some specimens exhibits a slight terminal expansion.

*Male:* This sex has not been taken.

*Distribution.*—Only known from the type locality.

## GROUP II.

## CULICOIDES ROBERTSI, n. sp.

*Types:* Holotype ♀ and 32 ♀♀ paratypes, allotype ♂ and five ♂♂ paratypes. Holotype, allotype and paratype series in SPHTM. Paratypes in BM, USNM, CSIRO and QIMR. All on slides.

*Type Locality.*—Yeerongpilly, Queensland, 15:iv:1952, R. F. Riek (in light trap). All ♂♂ same data except date which is April, 1952.

*Distinctive Characters.*—A small dark species with characteristic wing markings unlikely to be confused with any other known Australian species. This is also the only species in which the eye margins are fused below the frons.

*Description.*—From the type series except for coloration characters which are from pinned specimens taken with the ♂♂ of the type series. The holotype provided the individual measurements, a series of ten paratypes the average measurements. Measurements of the male sex are from the six male specimens in the type series (Table 1).

*Female.*

The head is almost black, with brown antennae. Scutum with simple pattern (Text-fig. 87) consisting of a median greyish longitudinal band about one-third the width of the scutum, flanked on either side by a dark brown longitudinal band and laterally to these a longitudinal brownish-grey area changing to dark brown at the lateral and anterior margins. At about two-thirds from the anterior margin, within the median grey band are two rounded black spots which in some specimens are also produced longitudinally as bands. The scutellum is dark brown, the pleura and coxae black. Legs brown, lighter distally. Wings with spotting of moderate strength anteriorly, weaker on posterior half of wing. Halteres light yellowish-brown. Abdomen black.

*Head:* Eyes contiguous (Text-fig. 10) and hence no inter-orbital hair. Antennae (Text-fig. 28) with basal flagellar segments a little longer than wide, subcylindrical, distal five normally elongate. Palpi (Text-fig. 47) with segments II–V not grossly varying in size, segment III very slightly swollen with single round sensory pit. Length of mouth-parts slightly less than height of head.

*Thorax:* Legs without any obvious modifications, tibial comb of hind leg of five equal spines. Wing pattern as in Plate xvi, fig. 13.

*Abdomen:* Spermathecae (Text-fig. 66) comprising two spherical normal organs with short chitinous ducts, one rudimentary spermatheca with very small knob and longer duct and an additional short chitinized duct.

*Male.*

Similar to female in essential characters. Genitalia: The ninth tergite lacks the usual horns at the distal corner and the harpes are very simple structures (Text-fig. 81).

*Distribution.*—QUEENSLAND: Eidsvold, 25:iv:1924 (Bancroft); Chinchilla, 13:xii:1949 (from horse); Texas, 24:iii:1952 (Reye, biting man); Yeerongpilly, 5:v:1938 (Roberts), 1:ii:1950 (Riek, in light trap), 3:i:1952 (Riek, in light trap), 15:iv:1952 (Riek, in light trap). NEW SOUTH WALES: Ballina, 2:ii:1952 (Reye, biting man and in rabbit-baited trap in mangrove zone); Clarence R., i:1950 (from horse).

## CULICOIDES ANTENNALIS, n. sp.

*Types:* Holotype ♀ and 20 ♀♀ paratypes, all on slides. Holotype and paratype series in SPHTM, paratypes in BM, USNM, QIMR and CSIRO.

*Type Locality.*—Hornsby, New South Wales, 6:x:1951 (D. J. Lee) for holotypes, same data but different dates (27:ix:1951, 4:x:1951 and 6:x:1951) for paratypes.

*Distinctive Characters.*—A large species, only likely to be confused with *C. bancrofti*. The distribution of wing spots is rather similar in the two, but the spot over r-m is often smaller in *C. antennalis*. The antennae with unusually long vasiform basal flagellar segments are similar in both species, but the sensory organs of the third segment of the palp are quite distinct. A single pit of moderate size is present in

*C. antennalis*, whereas there is a multiplicity of small pits over this segment in *C. bancrofti*.

*Description*.—Based on the type series and pinned specimens from Hornsby, 29:x:1951 (B. McMillan). Measurements are from the holotype and a series of ten paratypes (Table 1).

*Female*.

A large very dark species. The head, including antennae and palpi, is almost black. The scutum is very dark brown with a limited lighter pattern in the prescutellar area only. Scutellum and sides of thorax very dark brown. The legs, including the tarsi, are dark brown, but Tarsus I is a little paler at the base. The wings are rather dark with definite but not outstanding pattern of yellowish spots and the halteres have brown stems with the knobs whitish or creamy except near the junction with the stem where they are dark. The abdomen is very dark brown.

*Head*: Eyes moderately separated (Text-fig. 11), mouth-parts at least equal in length to height of head. Basal flagellar segments of antennae elongate and vasiform in shape, distal segments more elongated, contrast between the two not great but antennae obviously long (Text-fig. 29). Third segment of palp long with single sensory pit of unusual shape (Text-fig. 48).

*Thorax*: Legs unmodified, Tarsus IV cylindrical, tibial comb of four spines. Wings (Plate xvi, fig. 14) with moderately dense macrotrichia over most of surface. The pale spot over r-m is variable in size.

*Abdomen*: Two almost equal spherical spermathecae, each with a short chitinized duct (Text-fig. 67).

*Male*: No specimens of this sex have been taken.

*Distribution*.—NEW SOUTH WALES: Palm Beach, 2:iii:1946 (D. J. Lee); Hornsby, 29:x:1950 (D. J. Lee, 5 p.m.), (B. McMillan), xi:1950 (D. J. Lee, light trap), 2:xi:1950 (D. J. Lee, biting on ridge, 5.45–6.15 p.m.), 27:ix:1951 (D. J. Lee, light trap), 4:x:1951 (D. J. Lee, light trap), 6:x:1951 (D. J. Lee, light trap), 9:x:1951 (D. J. Lee); Heathcote, 5:viii:1946 (J. Henry, caught on rise and biting in gorge).

CULICOIDES BANCROFTI, n. sp.

*Types*: Holotype ♀ and one ♀ paratype, mounted on slides, and four pinned ♀♀ paratypes, all in SPHTM.

*Type Locality*.—Hornsby, New South Wales, 29:x:1950 for holotype, 2:xi:1950 for all paratypes (D. J. Lee, in gully and on ridge, some biting).

*Distinctive Characters*.—Only to be confused with *C. antennalis* under which species the distinctive features are discussed.

*Description*.—From the type series. Measurements are of the holotype and of a series of three specimens, one a paratype, another from Hornsby and a third from north of Coff's Harbour (Table 1).

*Female*.

A large very dark species with brownish wings. The head is black with very dark brown antennae and palpi. Thorax very dark brown, almost black, with greyish pattern on scutum restricted to posterior half (see Text-fig. 88). The legs including the tarsi are very dark, with a pre-apical paler brown band on all femora and a lighter band at the base of each tibia. Wings with membrane brownish, this coloration being particularly noticeable along the anterior third; the pale spots rather yellowish in colour. Halteres yellowish, abdomen dull black.

*Head*: Eyes narrowly separated (Text-fig. 12). Antennae with basal flagellar segments elongate and vasiform, distal segments a little more elongate and cylindrical, total length of antennae obviously long (Text-fig. 30). Third segment of palpi very much lengthened but not expanded, many small sensory pits present, diffusely arranged over most of the segment, a few also present on the second segment (Text-fig. 49).

*Thorax*: Legs unmodified, Tarsus IV cylindrical, wings with moderately dense macrotrichia over most of membrane, pattern as in Plate xvi, fig. 16.

*Abdomen*: Two almost equal spherical spermathecae each with short duct (Text-fig. 68).

*Male*: This sex is unknown.

*Distribution*.—QUEENSLAND: Jimna, 9:x:1948 (J. L. Wassell, 7 p.m., at light). NEW SOUTH WALES: North of Coff's Harbour, 27:ix:1950 (M. J. Mackerras, biting midday, raining, in forest); Hornsby Gully, 29:x:1950 (D. J. Lee, 1700 hrs.), (B. McMillan), 2:xi:1950 (D. J. Lee, biting, on ridge, 5.45-6.15 p.m.); Fitzroy Falls, 22-27:xi:1937 (A. L. Tonnoir).

CULICOIDES MAGNIMACULATUS, n. sp.

*Types*: Holotype ♀ and 12 ♀♀ paratypes mounted on slides. Holotype and paratype series in SPHTM, paratypes in BM, USNM, QIMR and CSIRO.

*Type Locality*.—All of type series from Cooranbong, New South Wales, 24:ix:1949 (B. McMillan).

*Distinctive Characters*.—A species with a very obvious pattern of large pale spots, with only one such spot in each of the intercalary fork and cell M, and a particularly extensive pale area over the basal portion of the wing. The extent of the pale areas is somewhat similar to that found in *C. magnesianus*, but the degree of contrast is markedly stronger and much of the second radial cell is pale instead of entirely dark as in *C. magnesianus*.

*Description*.—From the type series, additional characters of coloration from pinned specimens from Woy Woy, 22:ix:1923 (Mackerras). Measurements are from the holotype and a series of ten paratypes (Table 1).

*Female*.

Head, antennae and palpi dark brown. Scutum dark brown along the anterior margin to just beyond humeral pits, elsewhere with a greyish or yellowish brown pattern, the most prominent feature of which is a broad median longitudinal greyish band. Scutellum dark brown at the centre, greyish-brown at the sides. Legs brown with lighter bands just before apices of the femora and at bases of the tibiae. Wing pattern of strong contrast. Halteres creamy, abdomen dark brown.

*Head*: Eyes moderately separated (Text-fig. 13). Antennae with basal flagellar segments approximately twice as long as broad, widest near base and tapering slightly distally, distal segments normally elongate, the contrast between the two not particularly marked (Text-fig. 31). The third segment of the palpi slightly swollen, with a single irregularly oval sensory pit (Text-fig. 50). Mouthparts not quite as long as height of head.

*Thorax*: Legs unmodified, tibial comb of four spines. Wings with moderately dense macrotrichiae, pattern as in Plate xvi, fig. 15.

*Abdomen*: Two subequal subspherical spermathecae, each with a short chitinized duct together with a third longer chitinized duct (Text-fig. 69).

*Male*.

A specimen from Oatley Park, 27:ix:1952 (E. J. Reye) has been used for the illustration of the harpes (Text-fig. 82).

*Distribution*.—QUEENSLAND: COOROY, 2:v:1949 (M. J. Mackerras, biting); Mountain Cr., Buderim Mt., 24:viii:1947 (J. L. Wassell, biting, 1600 hrs.); Burpengary (E. J. Reye); Maroon, 18:ix:1948 (E. N. Marks, biting in forest country about 4 p.m.); Deception Bay, 7:viii:1951 (E. J. Reye, emergence trap on dam); Brisbane, 20:xi:1949 (from horse); Yeerongpilly, 9:viii:1951 (E. J. Reye, light trap); Dunwich (M. J. Mackerras, biting); Tambourine, 17:xi:1949; Mudgeraba Cr., 26:viii:1950 (M.J.M.); Lamington National Park, 24:ix:1950 (M. Crust). NEW SOUTH WALES: Noonameene, via Bingara, 20-24:x:1952 (A. L. Dyce, dusk to 10.30 p.m.); N. of Coff's Harbour, 27:ix:1950 (M. J. Mackerras, biting midday); Nyngan, viii:1948 (J. Armstrong,



biting); Molong Cr., Mt. Canoblas, 8:x:1950 (M. J. Mackerras); Ben Buckley, via Mudgee, 16:v:1952 (B. V. Fennessy, on human); Gumni Plain, 3:iii:1951 (B. McMillan, aspirated 5 p.m., 3800'); Barrington, Rocky Crossing, 6:iii:1951 (B. McMillan); Nelson's Bay, 14:viii:1949 (B. McMillan), 4:vi:1950 (B. McMillan, 500'); Anna Bay, 21:viii:1949 (B. McMillan, biting); Cooranbong, 28:v:1949 (B. McMillan), 4:vii:1949 (B. McMillan, 1400'); 24:ix:1949 (B. McMillan), 1:vi:1951 (B. McMillan); Woy Woy, 22:ix:1923 (Mackerras); Camp, Lett R., Hartley, 13:x:1950 (M. J. Mackerras, biting); Mt. Solitary, 23:ix:1951 (B. McMillan, some biting 9 a.m.); Blue Gum Forest, Blue Mts., 1:iv:1950 (B. McMillan, biting); Springwood, 16:iv:1950 (B. McMillan, biting); Woodford, x:1950 (K. J. Clinton); Little Mackeral Beach, Pittwater, 9:ix:1951 (B. McMillan, biting); Hornsby Gully, 28:x:1950 (D. J. Lee, 5.30-6 p.m.); Hornsby, 14:v:1949 (B. McMillan), 9:x:1950 (D. J. Lee), xi:1950 (D. J. Lee, light trap), 6:xii:1950 (D. J. Lee, light trap), 15:xii:1950 (D. J. Lee, light trap), 16:xii:1950 (D. J. Lee, light trap), 22:ix:1951 (D. J. Lee, some biting), 27:ix:1951 (D. J. Lee), 1:x:1951 (D. J. Lee), 4:x:1951 (D. J. Lee), 10:x:1951 (D. J. Lee); McCarr's Cr., 29:iv:1949 (D. J. Lee, sea level, mangroves); Narrabeen, 29:ix:1948 (B. McMillan); Oatley Bay, 27:ix:1952 (E. J. Reye, net); Sutherland, 17:viii:1920 (Mackerras); Burraneer Bay, 25:xi:1950 (Kinsela); National Park, 1:i:1926 (Mackerras), 12:xi:1949 (B. McMillan); Uloola Falls, National Park, 23:x:1949 (B. McMillan); Woronora Gorge, 11:x:1952 (E. J. Reye, net, 1200-1600 hrs.); Heathcote, 12:v:1946 (J. R. Henry), 5:viii:1946 (J. R. Henry, caught on rise and biting in gorge), 5:iv:1947 (J. R. Henry), 3:iv:1949 (J. R. Henry), 21:ix:1949 (J. R. Henry); Leumeah, 20:x:1951 (B. McMillan); Mittagong, 17:x:1945 (D. J. Lee); Upper Shoalhaven R., 30:iv:1950 (B. McMillan, biting); Milton, 20:x:1947 (biting man); Merimbula, 17:xi:1948 (E. Pratt); Parklea (N.S.W. Dept. Agric.). VICTORIA: Mt. Cobberas, 1:i:1952 (K. Harper, biting). SOUTH AUSTRALIA: Winkie, near Berri, x:1947 (H. J. Davis, biting man). TASMANIA: Strahan, 6:ii:1923 (A. Tonnoir); Queenstown (F. Worsnop).

CULICOIDES CUNICULUS, n. sp.

*Types:* Holotype ♀ and 4 ♂♂ paratypes, all slide specimens, in SPHTM.

*Type Locality.*—Noondoo, Queensland, 30:iii:1952 (E. J. Reye, in rabbit burrow, 1400 hrs). (All specimens.)

*Distinctive Characters.*—This is not a striking species, but the inclusion of the distal portion of the second radial cell within a pale area will distinguish it from *C. ornatus*, to which species there is most superficial resemblance. A distinctive character is the presence of two pale areas in the intercalary fork associated with short antennae with no marked contrast between the basal and distal flagellar segments and palpi with a large, very irregularly shaped sensory pit.

*Description.*—From the type series only, no unmounted material available for details of coloration. Measurements are from the holotype and the series of four paratypes (Table 1).

*Female.*

*Head:* Eyes widely separated (Text-fig. 14). Antennae (Text-fig. 32) with basal flagellar segments subcylindrical, slightly wider near base, distal segments elongate but no marked contrast between the two. Third segment of palpi with greatest expansion at middle and a large irregularly-shaped sensory pit (Text-fig. 51). Mouth-parts rather less in length than height of head.

*Thorax:* Legs unmodified, Tarsus IV cylindrical, pale markings just before end of femora on first and second pairs of legs and basally on all tibiae. Tibial comb usually of five, occasionally of six spines. Wings with pattern of only moderate contrast, macrotrichia rather sparse. (See Plate xvi, fig. 17.) Halteres pale.

*Abdomen:* Two subequal ovoid spermathecae each with a short chitinized duct together with a third chitinized duct (Text-fig. 70).

*Male:* This sex is not yet known.

*Distribution.*—Queensland: Only known from the type locality.

## CULICOIDES DYCEI, n. sp.

*Types*: Holotype ♀, allotype ♂, 21 ♀♀ and 3 ♂♂ paratypes, all slide specimens. Holotype, allotype and paratype series in SPHTM, paratypes in BM, USNM, QIMR and CSIRO.

*Type Locality*.—Entire type series from Moree, New South Wales (A. L. Dyce).

*Distinctive Characters*.—*C. dycei* and *C. mcmillani* both have three distinct spots in the intercalary fork associated with a single pale spot in cell  $M_1$ . The most obvious differences between the two are the short, rather wide third palpal segments of *C. dycei* as compared with the elongated third palpal segment of *C. mcmillani* and the short antennae of the former in marked contrast to the elongated antennae of the latter.

*Description*.—From the type series and for coloration characters pinned specimens from Bundy, via Moree, v:1952 (E. J. Reye). Measurements have been taken from the holotype, a series of ten paratypes and for the male sex a series of six specimens comprising allotype, three paratypes and two specimens from Texas, 20:i:1952 (Table 1).

*Female*.

A small brownish species with distinctly mottled wings. Head, antenna and palpi dark brown. Thorax dark brown, scutum with distinct pattern of grey spots (Text-fig. 89). Scutellum dark brown. Legs brown with preapical pale spots on all femora and basal pale spots on all tibiae. Halteres pale yellowish. Abdomen dark brown.

*Head*.—Eyes moderately separated (Text-fig. 15). Antennae (Text-fig. 33) with basal flagellar segments cylindrical, distal segments a little more elongate with no striking differentiation between the two. Third segment of the palpi short but expanded, a single large sensory pit (Text-fig. 52). Mouthparts not as long as height of head.

*Thorax*: Legs unmodified, Tarsus IV subcylindrical, tibial comb of four spines. Wings with rather sparse macrotrichia, pattern as in Plate xvi, fig. 18.

*Abdomen*: There are no chitinized spermathecae.

*Male*: Similar, apart from sexual differences, to the female; harpes as in Text-figure 83.

*Distribution*.—QUEENSLAND: Gootchie, 20:vii:1952 (E. J. Reye, 1600 hrs., net); Texas, 20:i:1952 (A. L. Dyce), 22:ii:1951 (E. J. Reye, light trap 1930-0545 hrs.). NEW SOUTH WALES: Gravesend, 12:vi:1952 (E. J. Reye, net, 1630 hrs.); Yagobie, 12:vi:1952 (E. J. Reye, net, 0815 hrs.), 3:xii:1951 (A. L. Dyce, light trap); Moree (A. L. Dyce), 22:xi:1951 (A. L. Dyce, mercury vapour light trap, 8.30-10 p.m.), 25:xi:1951 (A. L. Dyce, M.V. trap, 6.30-8.30 p.m.); Bundy, x:1951 (A. L. Dyce, light trap), 7:xi:1951 (A. L. Dyce, rabbit modified trap 9.30-11.30 a.m.), 6:xii:1951 (A. L. Dyce, M.V. trap, 6-9 p.m.), 6-7:xii:1951 (A. L. Dyce, 5 p.m. to 10 a.m., live rabbit trap, suction), iv:1952 (E. J. Reye, net), 24:v:1952 (E. J. Reye, light trap, 2345 hrs.), 10:vi:1952 (E. J. Reye, net, 1600 hrs.).

## CULICOIDES MULTIMACULATUS Taylor.

Taylor, F. H., 1918. *Aust. Zoologist*, 1: 169.

Macfie, J. W. S., 1939. *Proc. Linn. Soc. N.S.W.*, 64: 556.

*Type*: Holotype ♀ in SPHTM (on three slides).

*Type Locality*.—Portsea, Victoria.

*Distinctive Characters*.—The type of this species remains unique. It is a large species with a strongly patterned wing. The three pale spots in the intercalary fork together with a single spot in cell  $M_1$  may cause confusion of this species with either *C. dycei* or *C. mcmillani*. The former is a considerably smaller species and there is only a single sensory pit on the third segment of the palp as compared with three irregular pits in *C. multimaculatus*; *C. mcmillani* is about as large as *C. multimaculatus*, but again there is only a single sensory pit on the third palpal segment. In *C. mcmillani* the latter segment is elongate and only slightly expanded at about two-thirds from the base, whereas in *C. multimaculatus* it is decidedly swollen with maximum breadth at about the middle.

Certain details are added to the previous descriptions, comprising a figure of the palp (Text-fig. 53) and a figure of segment 10 and 11 of the antennae (Text-fig. 34) to show the contrast between the basal and first distal flagellar segments. The wing pattern is reproduced in Plate xvi, fig. 19. Certain measurements from the holotype are given in Table 1.

*Distribution.*—The species is still only known from the type locality.

CULICOIDES MCMILLANI, n. sp.

*Type:* Holotype ♀ on slide in SPHTM.

*Type Locality.*—Bull's Swamp, Barrington Tops, New South Wales (B. McMillan, flying, 6 p.m., 4800 feet).

*Distinctive Characters.*—See under *C. dycei*.

*Description.*—From holotype and specimens listed below. No unmounted material available. Measurements are from the holotype and a series of three other specimens from Hartley, Woodford and Hornsby (Table 1).

*Female.*

*Head:* Eyes distinctly separated (Text-fig. 16), antennae with basal flagellar segments subcylindrical, distal ones elongate giving a definite but not exaggerated contrast (Text-fig. 35). The third segment of the palp is distinctly lengthened, slightly expanded, at about three-quarters from the base with a single large oval sensory pit (Text-fig. 54).

*Thorax:* The legs are unmodified, with Tarsus IV subcylindrical. There is a pale preapical band on the fore and mid femora and on all legs a pale band near the base of the tibia. Tibial comb of four spines. Wings with moderate macrotrichia, pattern as in Plate xvi, fig. 20. The halteres appear brownish on the basal half, lighter above.

*Abdomen:* Two subequal ovate spermathecae, each with a short duct together with two additional separate short chitinized ducts (Text-fig. 71, specimen from Woodford).

*Male:* This sex has not been taken.

*Distribution.*—NEW SOUTH WALES: Bull's Swamp, Barrington Tops, 4800 feet (B. McMillan, flying, 6 p.m.); Nelson's Bay (B. McMillan); Camp, Lett R., Hartley, 13:x:1950 (M. J. Mackerras, biting at dusk); Woodford, x:1950 (K. J. Clinton); Hornsby, 1:x:1951 (D. J. Lee).

CULICOIDES PARVIMACULATUS, n. sp.

*Types:* Holotype ♀ and 14 ♀♀ paratypes. Holotype and paratype series in SPHTM, paratypes in BM, USNM, QIMR and CSIRO.

*Type Locality.*—Leumeah, New South Wales, 20:x:1951 (B. McMillan).

*Distinctive Characters.*—This species is particularly distinctive because of the smallness of the individual pale spots of the wing. The arrangement is much the same as that in *C. marksi*, there being three spots in the intercalary fork associated with two in cell  $M_4$ , but all spots in *C. parvimaculatus* are small whereas all are large in *C. marksi*. There is also a considerable difference in form of the spermathecae of the two species.

*Description.*—From the type series, coloration characters from pinned material from Eidsvold, Queensland, 24:iv:1924 (Bancroft). Measurements are from the holotype and a series of ten paratypes (Table 1).

*Female.*

A small species, the head dark brown with narrow longitudinal greyish band on the vertex, pedicels of antennae dark brown, rest of antennae and palpi brown. Thorax dark brown, scutum with a distinct pattern of greyish spots (Text-fig. 90). Scutellum dark brown. Legs brown with a paler preapical band on the fore and mid femora and a similar basal pale band on all tibiae. Wings with strongly contrasting pattern, halteres light brown. Abdomen lighter brown than the thorax.

*Head:* Eyes rather narrowly separated (Text-fig. 17). Antennae with basal flagellar segments subcylindrical, distal segments elongate, the contrast between the two not

marked (Text-fig. 36). Palpi with a short expanded third segment, the greatest width being a little beyond the middle and with a single large sensory pit (Text-fig. 55). The mouth-parts rather less in length than height of head.

*Thorax*: Legs unmodified, Tarsus IV subcylindrical, tibial comb of four spines. Wings with moderate development of macrotrichia, pattern as in Plate xvi, fig. 22.

*Abdomen*: Three mushroom-like spermathecae, each with a duct approximately equal to height of knob, together with a fourth short isolated duct. Body of spermathecae variable in form, sometimes rounded, sometimes tapering to a blunt point.

*Male*.

A specimen from Hornsby, 11:i:1950 (D. J. Lee) has been used to provide a figure of the harpes (Text-fig. 84).

*Distribution*.—QUEENSLAND: Eidsvold, 24:iv:1924 (Bancroft); Tin Can Bay Rd., 17:iv:1949 (M. J. Mackerras, biting in tent). NEW SOUTH WALES: Springwood, 16:iv:1950 (B. McMillan); Hornsby, 14:v:1949, 11:xi:1950 (D. J. Lee, light trap), 4:x:1951 (D. J. Lee); Sutherland, 7:viii:1926 (I. M. Mackerras); Heathcote, 12:v:1946 (J. R. Henry), 21:ix:1949 (J. R. Henry); Leumeah, 20:x:1951 (B. McMillan).

#### CULICOIDES MARKSI, n. sp.

*Types*: Holotype ♀, allotype ♂, 12 ♀♀ and two ♂♂ paratypes. Holotype, allotype and paratype series in SPHTM, paratypes in BM, USNM, CSIRO and QIMR.

*Type Locality*.—All of type series from Yagobie, New South Wales, 3:xii:1951 (A. L. Dyce, light trap).

*Distinctive Characters*.—See *C. parvimaclatus*. *C. marksi* is another species with characteristic spermathecae. Three are developed, but only the distal half to two-thirds of each subequal sphere is chitinized.

*Description*.—From the type series, coloration characters from pinned specimen from Bundy, via Moree, v:1952 (E. J. Reye). Measurements are from the holotype, a series of ten paratypes and, for the male sex, the three specimens in the type series (Table 1).

*Female*.

A medium-sized dark species with head including palpi and pedicels of antennae dark brown, flagellum brown. Thorax dark brown, scutum with extensive greyish pattern (Text-fig. 91) and scutellum brown with lateral greyish patches. Legs brown with distinct preapical pale bands on all femora and basal pale bands on all tibiae. Wing pattern of strong contrast, halteres brown basally becoming whitish apically; abdomen dark brown.

*Head*: Eyes widely separated (Text-fig. 18). Antennae with basal flagellar segments subcylindrical, distal segments elongate, contrast not pronounced (Text-fig. 37). Third segment of palp expanded about two-thirds from base with a large single sensory pit (Text-fig. 56).

*Thorax*: Legs unmodified, Tarsus IV rather bell-shaped; tibial comb of four spines. Wings with macrotrichia only moderately developed, pattern as in Plate xvi, fig. 21.

*Abdomen*: The spermathecae comprise three subequal incomplete spheres (Text-fig. 73).

*Male*: The male harpes are figured in Text-fig. 85.

*Distribution*.—QUEENSLAND: Townsville, 12:vii:1952 (E. J. Reye, 1700 hrs., net); St. Lawrence, 16:vii:1952 (E. J. Reye, 1715 hrs., net); Roma, 11:v:1948 (J. L. Wassell, light trap, 9–10 p.m.); Dayboro, 7:viii:1951 (E. J. Reye, cultured from pond margin); Longreach (R. F. Riek); Yelarbon, 20:i:1944 (E. N. Marks); Texas, 22:xii:1951 (A. L. Dyce, light trap), 20:i:1952 (A. L. Dyce, light trap). NEW SOUTH WALES: Yagobie, 3:xii:1951 (A. L. Dyce, light trap); Moree, 30:x:1951 (A. L. Dyce), 22:xi:1951 (A. L. Dyce, mercury vapour light trap, 8.30–10 p.m.), 23:xi:1951 (A. L. Dyce, light trap), 25:xi:1951 (A. L. Dyce, M.V. trap, 6.30–8.30 p.m.), 4:v:1952 (A. L. Dyce, biting); Bundy, v:1952 (E. J. Reye), 24:v:1952 (E. J. Reye, 2300 hrs., light trap); 6:xii:1951



(A. L. Dyce, trap, 6-9 p.m.); Merrylands, ii:1952 (E. J. Reye, 1830 hrs.). VICTORIA: Murrayville, 20:ii:1952 (on human).

#### DOUBTFUL SPECIES.

There is only one previously described species which has not been recognized in any of the material seen by us. This is *C. brevitarsis* Kieffer, the description of which does not fit any of the species dealt with above and it seems that its identity must remain in doubt until such time as the type is re-examined.

We have not included this species in the key, and it may also be noted that the character from which it derives its specific name is common to most Australian species. However, in case anything resembling this species is taken a translation of the original description is included.

#### CULICOIDES BREVITARSIS Kieffer.

Kieffer, J. J., 1917. *Ann. Nat. Mus. Hung.*, 15: 187.

*Type*: Presumably in National Museum of Hungary, Budapest.

*Type Locality*.—Cited as Australia, no specific locality being mentioned.

*Distinctive Characters*.—It should be easy to recognize this species from the wing pattern which consists of no more than a smoky patch over the radial cells and a pale area over r-m which extends to the costa. Also we are not aware of any other Australasian species in which the  $M_{3+4}$ - $Cu_1$  fork is immediately below the distal extremity of  $R_{4+5}$ .

#### Translation of Original Description.

"♀. Reddish-brown, eyes glabrous, mouth-parts as long as the height of the head. Fifth segment of the palpi a little longer than the penultimate. Antennal segments 4-10 half as long again as wide, slightly thinner at the distal extremity, segments 11-15 elongated, 11-14 slightly thinner in their distal half, 11 almost half as long again as 10, scarcely shorter than 12, 13 a little longer than 12, a little shorter than 14, 15 the longest, obtuse distally, without stylet. Halteres yellowish. Wings hyaline, with a smoky patch on the two radial cells, surface with microscopic hairs resembling a fine dotting, distal extremity with some longer and sparse hairs, at the junction of  $R_{4+5}$  and r-m is found a transverse marginal space deprived of microscopic hairs and appearing whitish;  $R_{4+5}$  reaching the middle of the wing, at least half as long again as  $R_1$ , first radial cell a little longer than the second, both of them very narrow, r-m very long and oblique, as usual the bifurcation of M a little distal to r-m, that of the base of  $Cu_1$  on  $M_{3+4}$  is situated under the termination of  $R_{4+5}$ ,  $Cu_1$  very oblique. Legs pale yellow, slender, without long hairs, first tarsal segments of the four anterior legs as long as the four following segments together, first tarsal segments of the two posterior legs shorter and thicker, scarcely as long as the two following segments together, fourth segment distinctly shorter than the fifth, empodium absent. Length 1 mm."

*Distribution*.—This species has not since been recovered.

#### BIOLOGY.

A great deal of observation is still required to give even reasonable information on the breeding habits, life histories and general adult habits of the various species of *Culicoides*.

What little is known is in part revealed in the distribution lists for individual species, particularly such information as concerns observed blood-sucking habits.

Those deserving of consideration as pest species are *C. subimmaculatus*, *C. ornatus*, *C. molestus*, *C. marmoratus* and *C. magnimaculatus*. The first two are the commonest plague species of coastal areas where they occur. *C. molestus* has usually been considered the dominant pest species but, although it is frequently taken biting man, it often plays only a minor role in outbreaks of intense sandfly activity. On the other hand when sandfly activity is not particularly noticeable, as in the harbourside suburbs of Sydney, *C. molestus* is the usual species taken. *C. marmoratus* is again a pest, especially of coastal areas, but it is not so closely restricted to the vicinity of mangrove

areas as are *C. ornatus* and *C. subimmaculatus*. *C. magnimaculatus* is a widespread species often taken in considerable numbers attacking man and, although most commonly taken along the coastal gullies, is by no means restricted to such areas.

Other species which are known to bite man are *C. immaculatus*, *C. robertsi*, *C. antennalis*, *C. bancrofti*, *C. mcmillani*, *C. parvimaculatus* and *C. marksii*, but so far no instances are known of these species qualifying as dominant biting species. *C. robertsi*, however, is well known as a night-biting species attacking horses.

Breeding habitats are known for some seven species. *C. subimmaculatus* breeds in the low-lying estuarine zone covered by spring tides in the area between mangroves and actual dry land, often delimited by the presence of *Salicornia* (see Lee, 1949). *C. marmoratus* has been found breeding in the same type of area but other evidence would suggest that it is not necessarily limited to such areas. *C. angularis* has been found breeding in small rockholes in sandstone gullies and also in treeholes. *C. rabauli* (specimens from Heron I.) has also been bred from treeholes. *C. magnimaculatus*, *C. marksii* and *C. palpilis* have been bred from soil taken from the margins of ponds.

#### References.

Systematic references are quoted in full in the text, other references as in Part I of this series (these PROCEEDINGS, 1948, Vol. 72 (for 1947), pp. 330-331) with the following additions:

LEE, D. J., 1949.—Sandfly Breeding Places. *Aust. J. Sci.*, 12: 74-75.

WIRTH, W. W., 1952.—The Heleidae of California. *Univ. Calif. Pub. in Entom.*, Vol. 9, No. 2: 95-266.

#### EXPLANATION OF PLATE XVI.

Wing photographs. (× 30.)

1, *C. immaculatus*; 2 and 3, the different types of spotting seen in *C. palpilis*; 4, *C. subimmaculatus*; 5, *C. ornatus*; 6, *C. molestus*; 7 and 8, two types of wing spotting seen in *C. marmoratus*; 9, *C. magnesianus*; 10, *C. rabauli*; 11, *C. angularis*; 12, *C. mackayensis*; 13, *C. robertsi*; 14, *C. antennalis*; 15, *C. magnimaculatus*; 16, *C. bancrofti*; 17, *C. cuniculus*; 18, *C. dycei*; 19, *C. multimaculatus*; 20, *C. mcmillani*; 21, *C. marksii*; 22, *C. parvimaculatus*.

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LINNEAN SOCIETY OF NEW SOUTH WALES

BACTERIOLOGY ACCOUNT.

BALANCE SHEET at 29th February, 1952.

LIABILITIES.		ASSETS.	
£	s. d.	£	s. d.
Accumulated Funds.		Fixed Assets.	
Amount bequeathed by Sir William Macleay	12,000 0 0	Commonwealth Loans, at cost	15,320 0 0
Accumulated Income Capitalized	6,120 0 0	Debentures:	
		Metropolitan Water, Sewerage and Drainage Board, at cost	800 0 0
Income Account at 29th February, 1952	993 2 6	Freehold Property, at cost	16,120 0 0
Commercial Banking Company of Sydney, Ltd.	857 9 8	Current Assets.	3,850 0 0
Current Liabilities.		Commonwealth Savings Bank	12 2
	1,850 12 2		
	£19,970 12 2		£19,970 12 2

INCOME ACCOUNT. Year Ended 29th February, 1952.

	£	s. d.	£	s. d.
To Salary	975	0 0	By Balance from 1950-51	1,171 12 6
" Equipment and Repairs	156	11 10	" Interest	543 1 7
" Insurance	16	11	" Donations	450 0 0
" Loss on sale of bonds	80	16 3	" Rent	151 13 4
" Ramsgate Property:				
Stamp Duty	39	0 0		
Legal Expenses	46	14 11		
Insurance	5	13 6		
Rates	5	3 4		
Repairs	13	8 2		
" Balance to 1952-53	109	19 11		
	993	2 6		
	£2,316	7 5		£2,316 7 5

AUDITOR'S REPORT TO MEMBERS.

I have examined the books of account and vouchers of the Linnean Society of New South Wales for the year ended 29th February, 1952, and certify that the above Balance Sheet and accompanying Income Account are correct and in accordance therewith, and in my opinion present the true state of the Society's affairs at 29th February, 1952, as shown by the books. Certificates of the investments have been inspected.

S. J. RAYMENT, Chartered Accountant (Aust.),  
 Auditor.  
 3rd March, 1952.

A. B. WALKOM,  
 Hon. Treasurer.

## ABSTRACT OF PROCEEDINGS

### ORDINARY MONTHLY MEETING.

26th MARCH, 1952.

Mr. S. J. Copland, President, in the Chair.

Library accessions amounting to 51 volumes, 375 parts or numbers, 10 bulletins, 6 reports and 12 pamphlets, total 454, had been received since the last meeting.

#### PAPERS READ (by title only).

1. A Check List of the Trombiculid Larvae of Asia and Australasia. By Carl E. M. Gunther.
2. Ecological Classification and Nomenclature. By N. C. W. Beadle and A. B. Costin. With a Note on Pasture Classification, by C. W. E. Moore.

### ORDINARY MONTHLY MEETING.

30th APRIL, 1952.

Mr. S. J. Copland, President, occupied the Chair.

The President announced that the Council had elected the following Office-bearers for the 1952-53 session: Vice-Presidents: Dr. Lilian Fraser, Dr. A. R. Woodhill, Mr. D. J. Lee and Mr. A. N. Colefax; Honorary Treasurer: Dr. A. B. Walkom; Honorary Editor: Dr. A. B. Walkom; Honorary Secretary: Dr. W. R. Browne.

The following were elected Ordinary Members of the Society: Professor Charles Baehni, Dr.sc., Geneva, Switzerland; Mr. Alan L. Dyce, B.Sc.Agr., Canberra, A.C.T.; Mr. John M. Monro, Armidale, N.S.W.; Rev. Robert G. Palmer, Glen Davis, N.S.W.; Mr. Milton J. Slade, Cessnock, N.S.W.; and Mr. Owen B. Williams, B.Agr.Sc., Deniliquin, N.S.W.

Library accessions amounting to 10 volumes, 78 parts or numbers, 7 bulletins, 4 reports and 8 pamphlets, total 107, had been received since the last meeting.

The papers taken as read at the March Ordinary Monthly Meeting were discussed.

#### PAPERS READ.

1. Studies of Nitrogen-fixing Bacteria. I. A Note on the Estimation of *Azotobacter* in the Soil. By Y. T. Tchan, Macleay Bacteriologist.
2. Studies of Nitrogen-fixing Bacteria. II. The Presence of Aerobic Non-symbiotic Nitrogen-fixing Bacteria in Soils of the Sydney District. By Y. T. Tchan, Macleay Bacteriologist.
3. A Note on the Stratigraphy and Structure of the Wellington-Molong-Orange-Canowindra Region. By Germaine Joplin and others.

#### NOTES AND EXHIBITS.

Dr. Y. T. Tchan exhibited and demonstrated an arrangement by which the Siedentopf Phoku attachment for photomicrographic work could be adapted for taking 35 mm. black and white or colour film.

Dr. N. C. W. Beadle showed a series of kodasliques to compare and contrast certain features of the Northern American and Australian vegetation, and some slides showing the features of the laterite profile and its use as a building material in Ceylon.

### ORDINARY MONTHLY MEETING.

28th MAY, 1952.

Mr. S. J. Copland, President, occupied the Chair.

Mr. D. H. Ashton, B.Sc., Surrey Hills, Victoria, was elected an Ordinary Member of the Society.



The President offered congratulations to Miss Helen Lancaster on obtaining her M.Sc. degree of the University of Sydney.

Library accessions amounting to 20 volumes, 117 parts or numbers, 21 bulletins, 1 report and 2 pamphlets, total 161, had been received since the last meeting.

## PAPERS READ.

1. Ordovician Stratigraphy at Cliefden Caves, near Mandurama, N.S.W. By N. C. Stevens.

2. Taxonomic Notes on the Genus *Ablepharus* (Sauria: Scincidae). III. A New Species from North-west Australia. By Stephen J. Copland.

3. Notes on Australasian Simuliidae (Diptera). III. By I. M. Mackerras and M. J. Mackerras.

## NOTES AND EXHIBITS.

Dr. A. R. Woodhill exhibited a specimen of *Megarhinus speciosus*, one of the largest known mosquitoes, which is mainly tropical and sub-tropical but occurs in small numbers as far south as Sydney. The larvae are predaceous on other mosquito larvae but the adults are not blood-feeders.

Mr. S. J. Copland exhibited a specimen of the rare Scincid lizard, *Lygosoma truncatum*. It was one of three found in the Macpherson Ranges. Only two individuals were previously known—both from islands in Moreton Bay. This is the first mainland record.

A lecturette was given by Mr. D. P. Clark, entitled "Ecological Study of the Microfauna of the Soil".

## ORDINARY MONTHLY MEETING.

25th JUNE, 1952.

Mr. S. J. Copland, President, occupied the Chair.

Miss Julia M. Langley, B.Sc., Gordon; Mr. B. D. H. Latter, B.Sc.Agr., Coogee; and Mr. D. F. McMichael, B.Sc., Australian Museum, Sydney, were elected Ordinary Members of the Society.

The President offered congratulations to Professor N. A. Burges, who has accepted an invitation to the Chair of Botany in the University of Liverpool; and to Dr. Daphne Eliot (*née* Davison) and Dr. Ian Fraser, on obtaining the degree of Ph.D., of the University of Cambridge.

The President announced that a Special General Meeting will be held at 7.15 p.m. on Wednesday, 30th July, 1952, to consider an alteration of the Rules of the Society recommended by Council.

Library accessions amounting to 10 volumes, 91 parts or numbers, 3 bulletins and 6 pamphlets, total 110, had been received since the last meeting.

## PAPERS READ.

1. The Petrology of the Cowra Intrusion and Associated Xenoliths. By N. C. Stevens.

2. A Mainland Race of the Scincid Lizard, *Lygosoma truncatum* (Peters). By Stephen J. Copland.

Lecturettes on Mitochondria; Cytology and Function in Plants and Bacteria were given by Miss M. Hindmarsh, Dr. R. N. Robertson and Dr. Y. T. Tchan.

## SPECIAL GENERAL MEETING.

30th JULY, 1952, at 7.15 p.m.

Mr. S. J. Copland, President, occupied the Chair.

## BUSINESS.

To consider an alteration of the Rules of the Society recommended by the Council, by the addition of a rule xvii, reading as follows: The Council may decide that the duties of the Secretary as set out in Rule xlix shall be carried out by one or more

Honorary Secretaries. In this event the Council shall consist of eighteen members, and the Honorary Secretaries shall be Office-bearers to be elected by the Council in terms of Rules xxviii and xvi.

The adoption of the Council's recommendation was passed unanimously.

#### ORDINARY MONTHLY MEETING.

30th JULY, 1952.

Mr. S. J. Copland, President, occupied the Chair.

Messrs. R. W. Jessup, M.Sc., Armidale, N.S.W.; G. R. Meyer, Ryde, N.S.W.; and G. E. Sullivan, M.Sc. (N.Z.), Sydney University, were elected Ordinary Members of the Society.

The Chairman made the following announcements:

1. On account of the Sydney Meeting of the Australian and New Zealand Association for the Advancement of Science, which will take place from 20th to 27th August, 1952, inclusive, and the University Centenary Celebrations, there will be no Ordinary Monthly Meeting of the Society in August.

2. A Special General Meeting will be held on 24th September, 1953, at 7.15 p.m., to confirm the alteration of the Rules, adopted at the Special General Meeting on 30th July, 1952.

3. Individual members who wish to subscribe to the memorial to be erected in the Transvaal to the late Dr. Robert Broom should send their contributions to the Hon. Treasurer of the Society.

4. By decision of the Deputy Commissioner of Taxation, the Linnean Society has been approved as a scientific research institute, donations to which for purposes of research are tax-free.

Library accessions amounting to 11 volumes, 182 parts or numbers, 4 bulletins, 6 reports and 2 pamphlets, total 205, had been received since last meeting.

#### PAPERS READ.

1. Revision of the Genus *Calotis* R.Br. By Gwenda L. Davis.
2. Ropy Smut of Liverpool Plains Grass. By Dorothy E. Shaw.
3. Notes on *Phlebotomus* from the Australasian Region (Diptera: Psychodidae). By G. B. Fairchild. (*Communicated by D. J. Lee.*)
4. Australian Rust Studies. IX. Physiologic Race Determinations and Surveys of Cereal Rusts. By W. L. Waterhouse.

#### NOTES AND EXHIBITS.

Dr. N. C. W. Beadle exhibited, on behalf of himself and Professor N. A. Burges, a series of test-tubes containing laboratory-prepared laterite and illustrating the formation of a laterite soil-profile with reduced and bleached zones and zones of deposited oxidized iron. The maintenance of a fluctuating water-level and a high rate of microbiological activity leads to anaerobic conditions and the formation of ferrous iron at depth. This is deposited in oxidized form at the surface. In the laboratory the process can be accelerated by providing the micro-organisms with an additional carbon source such as glucose.

Mr. A. J. Bearup exhibited a small water crustacean, *Mesocyclops obsoletus*, with a larval tapeworm in the body cavity. The adult worm is a species of *Spirometra* (Cestoda-Dibothriocephalidae), a parasite of dogs and cats. Larval stages have been followed through Cyclopoida to tadpoles, thence to pigs and other animals and back to cats. Recently, many wild pigs bred in western New South Wales have been found to harbour the larvae (spargana) of this worm.

#### LECTURETTE.

A lecturette, illustrated by a film and exhibits, on the Natural History of Heard Island, was given by Mr. K. G. Brown, B.Sc., Biologist to the Australian Antarctic Expedition, 1951.